

Comparison of precipitation products and hydrologic simulations over the OLYMPEX domain

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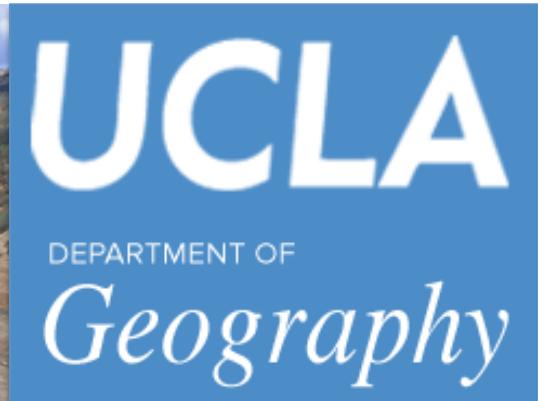
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PMM PI Meeting

Baltimore, MD



OLYMPEX domain (per Implementation Plan)

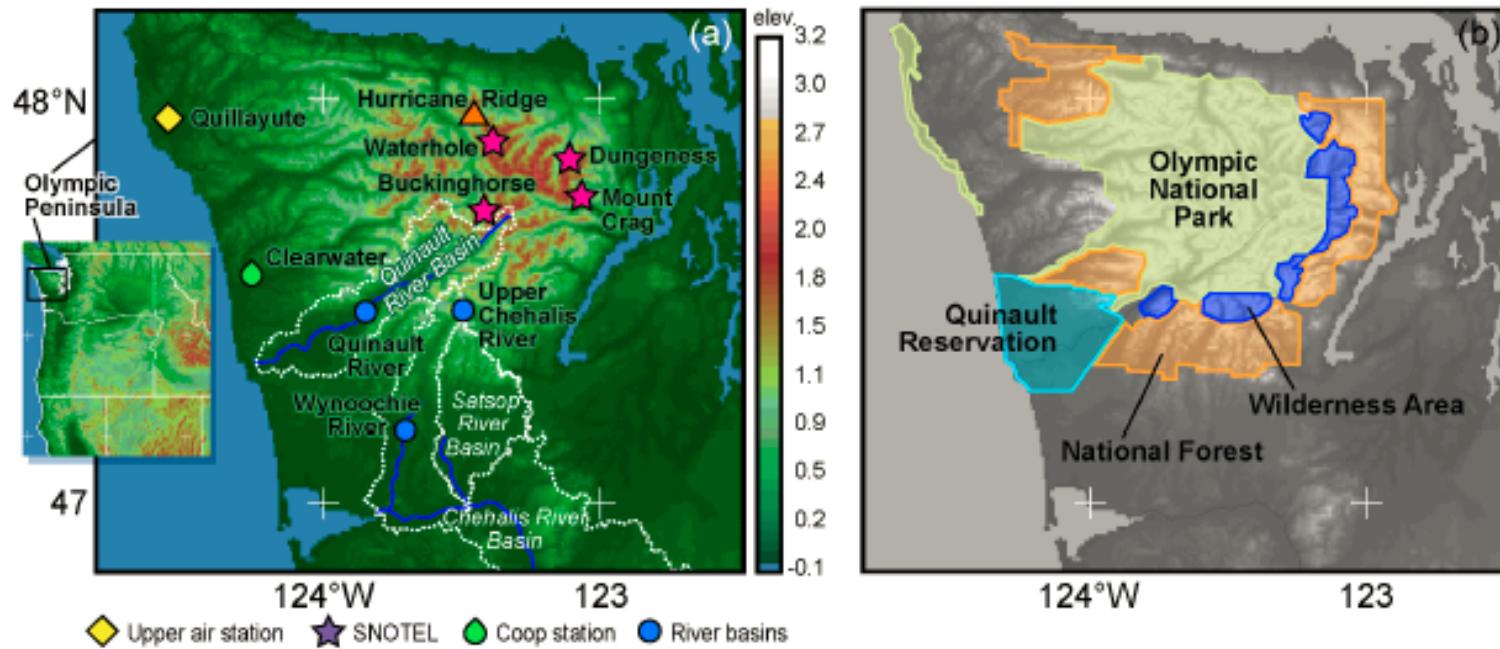


Figure 1: The Olympic Peninsula with terrain. (a) The Quinault, Satsop, and Upper Chehalis river basins are indicated along with the upper air station at Quillayute (yellow diamond), SNOTEL sites (pink stars), and the coop surface station at Clearwater (green teardrop). (b) The boundaries of the Olympic National Park, the Quinault Reservation and the National Forest Service Wilderness Areas and Olympic National Forest.

Outline

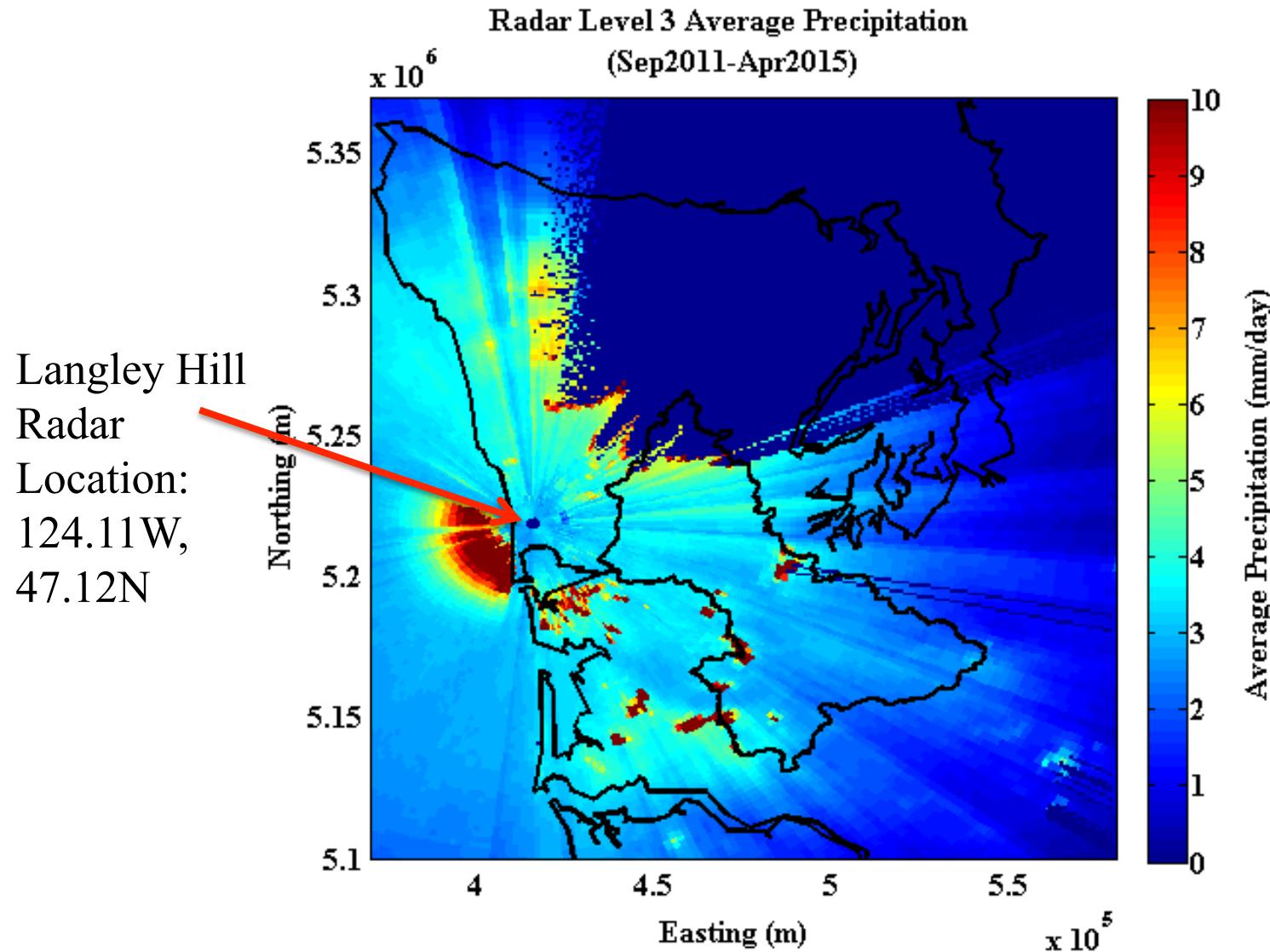
- (1) Comparison of precipitation products over the OLYMPEX domain
 - Gridded station data set of Livneh et al. (2013)
 - Drought Monitoring System for the Pacific Northwest
 - UWWRF real time forecast
 - Radar Level III and Stage IV
 - TMPA-RT
 - PERSIANN
- (2) Evaluation of extreme streamflow simulations for the Chehalis River Basin using updated gridded station data set
- (3) Airborne Snow Observatory and its role

Precipitation Data Sets

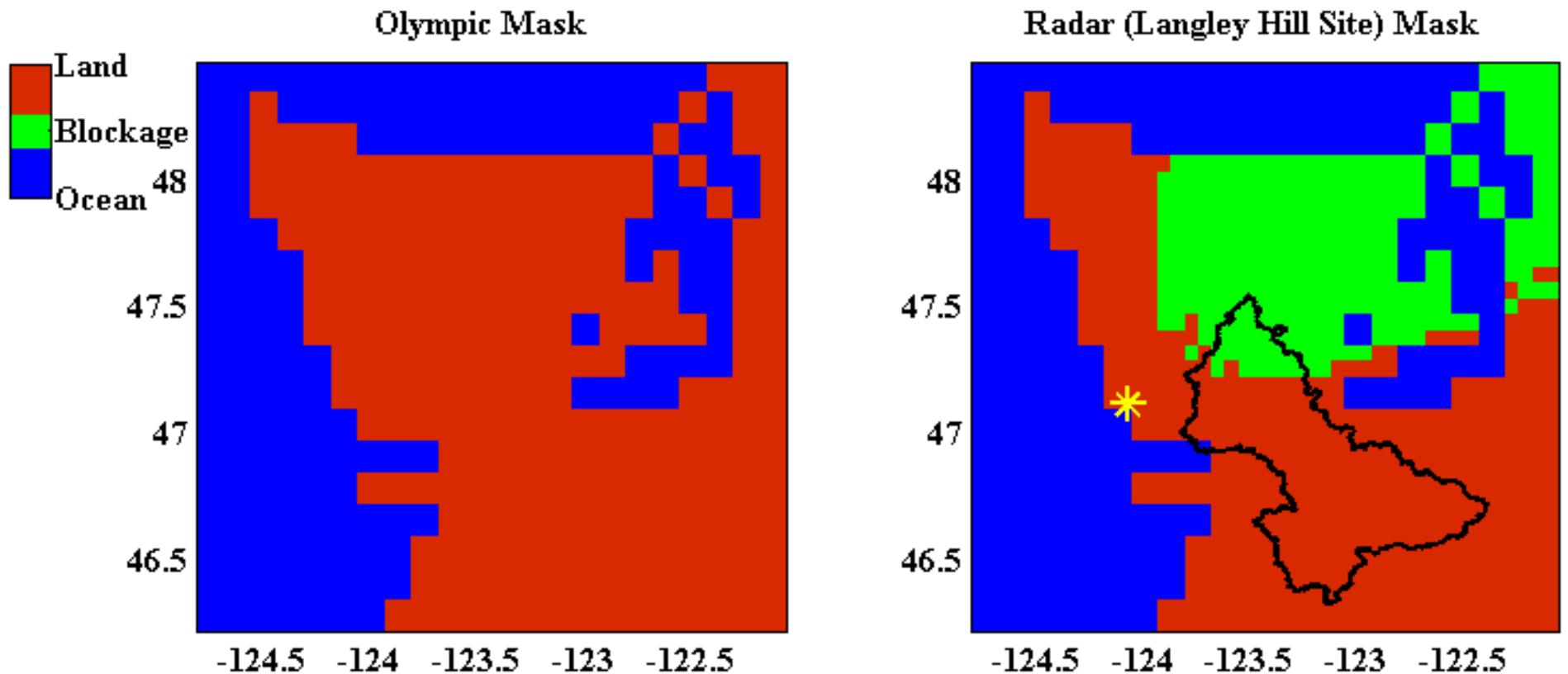
Dataset	Start Date	End Date
Radar(Level 3)	09/22/2011	05/15/2015
WRF (4Km)*	01/01/2009	12/31/2014
TMPA - RT	01/01/2009	04/26/2015
IMERG	03/12/2014	02/28/2015
Livneh et al.	01/01/2009	12/31/2014
PERSIANN	01/01/2009	12/31/2014
ST – IV	01/01/2011	03/31/2015
Drought Monitoring	01/01/2014	05/01/2015

* Not available in February and March 2014

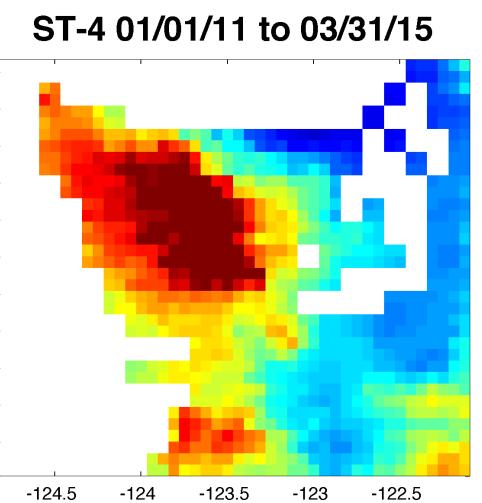
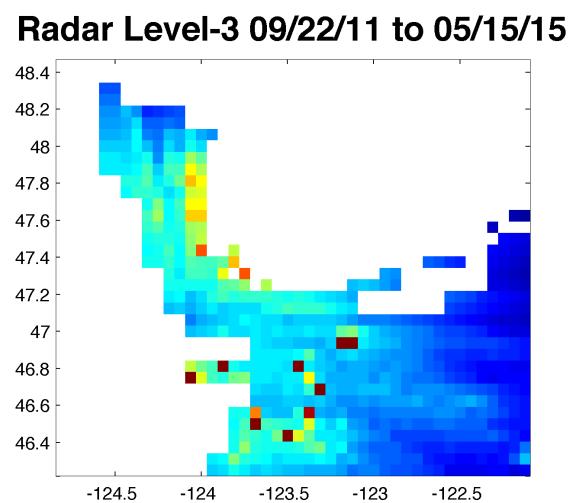
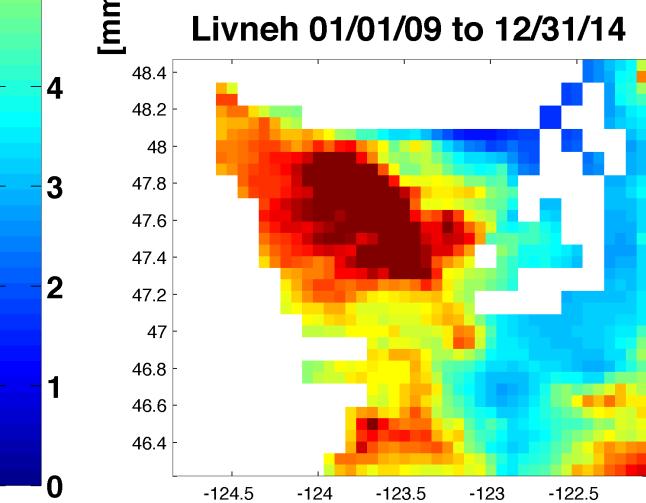
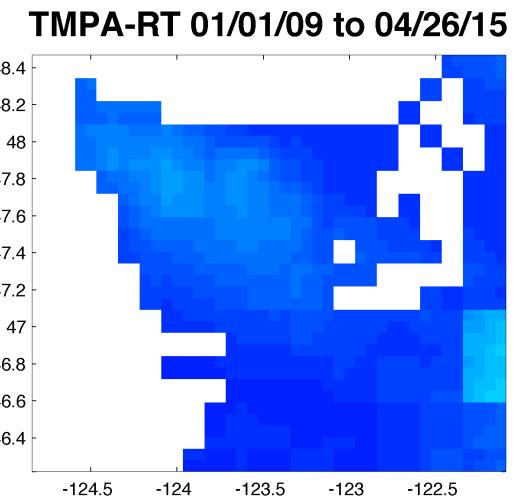
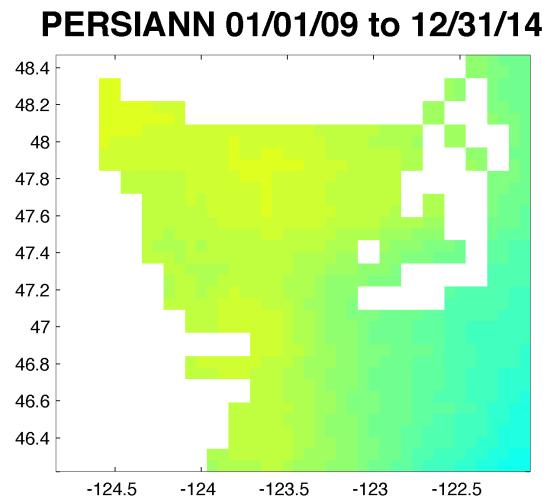
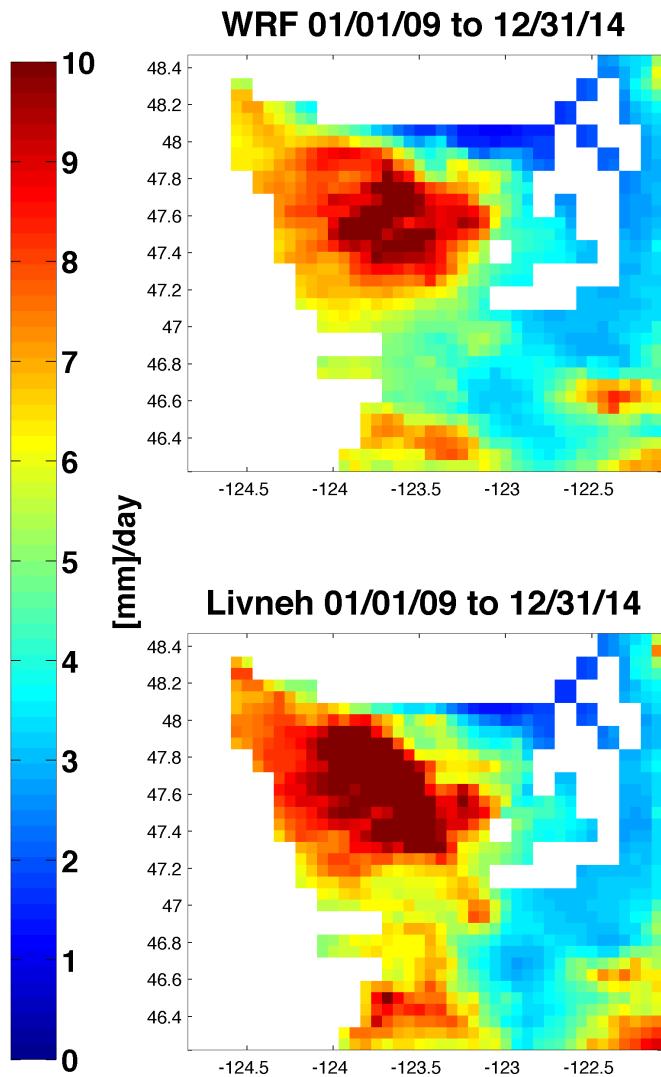
Langley Hill (NWS WSR-88D) Radar Level III Precipitation Map



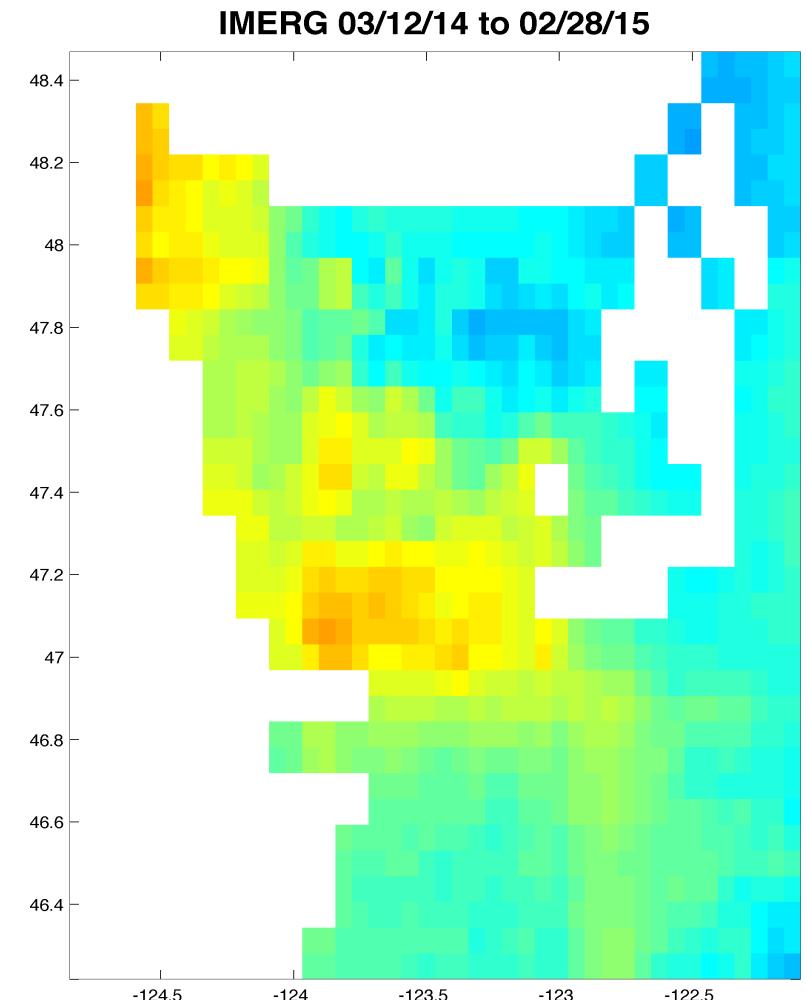
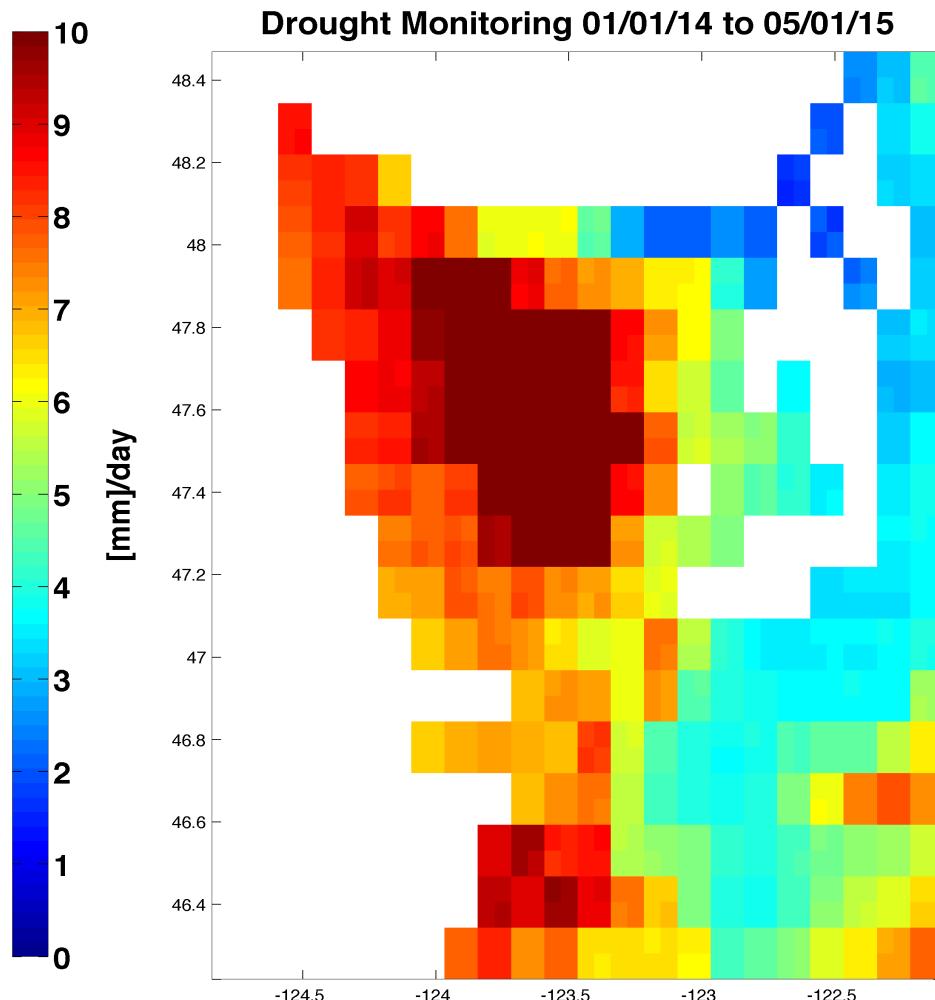
Langley Hill radar terrain blockage over OLYMPEX domain



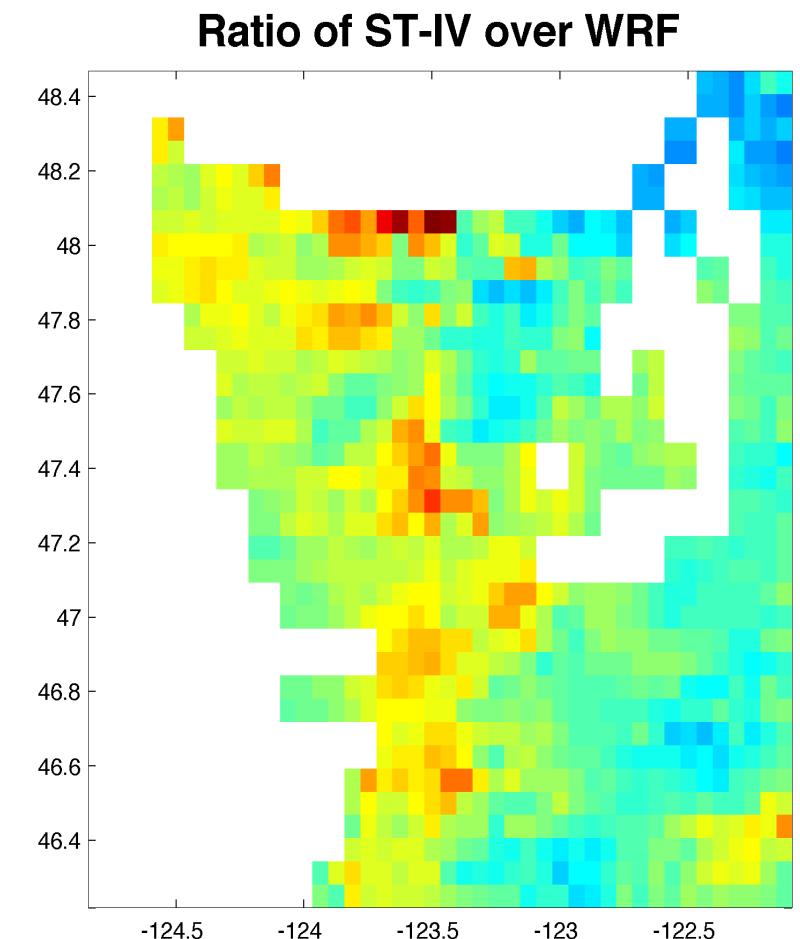
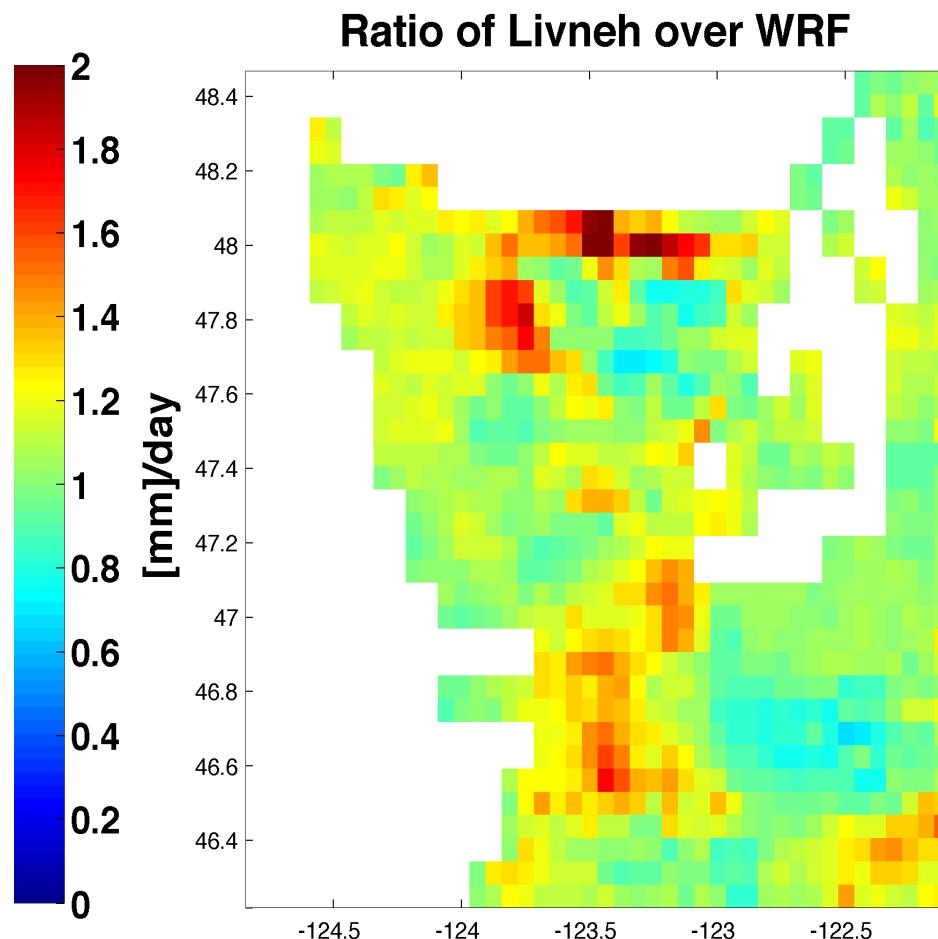
Average Daily Precipitation Comparison Over Olympic Peninsula



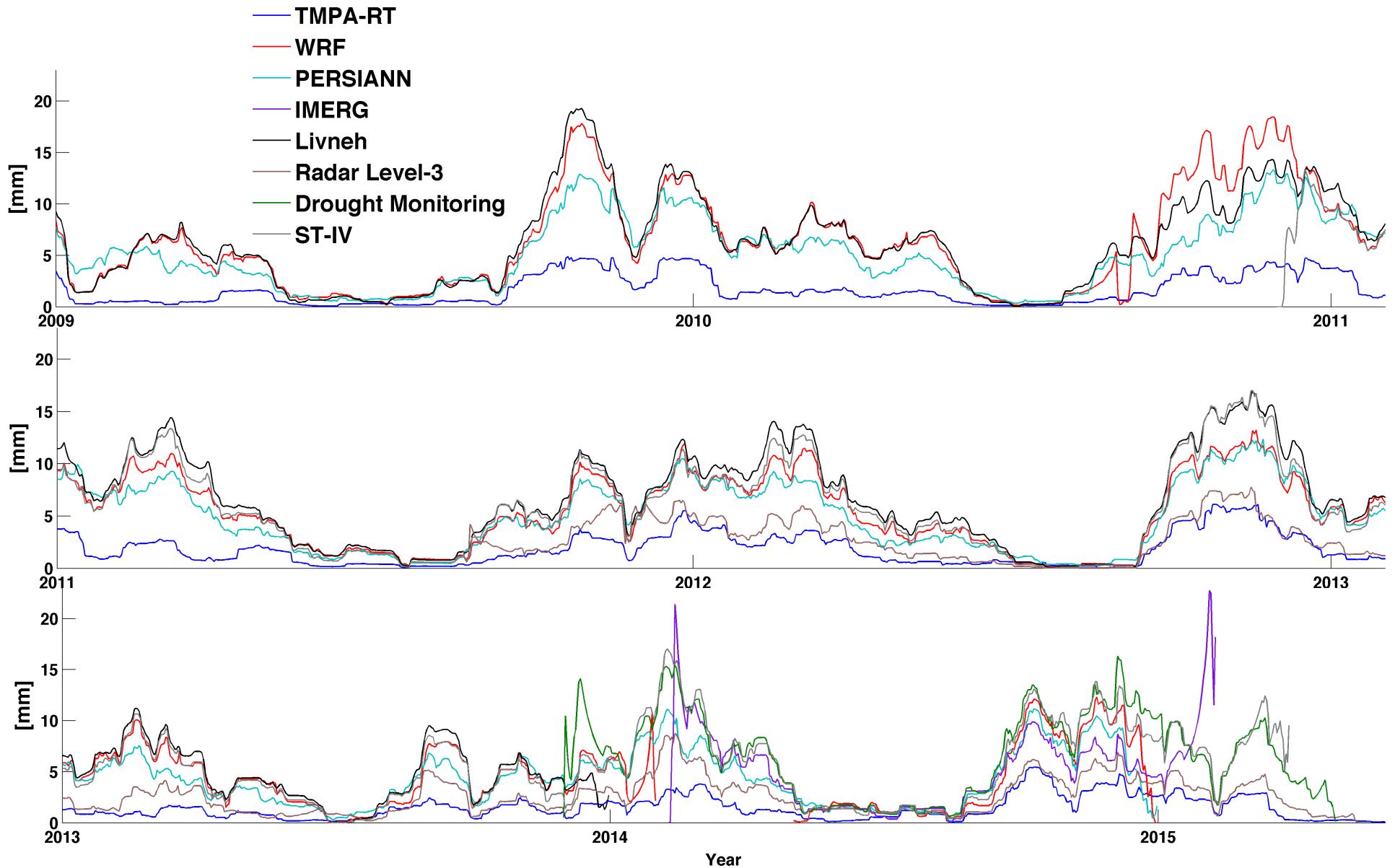
Average Daily Precipitation Comparison – UW DM and IMERG



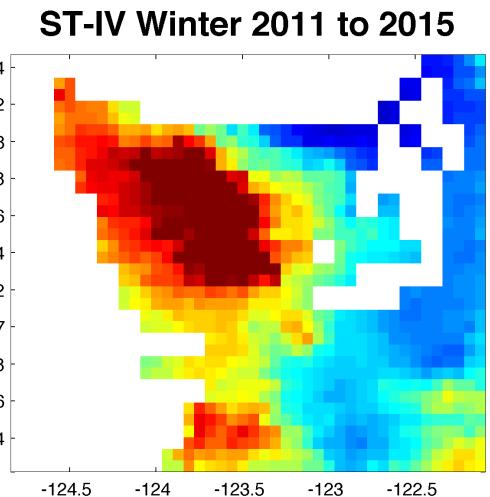
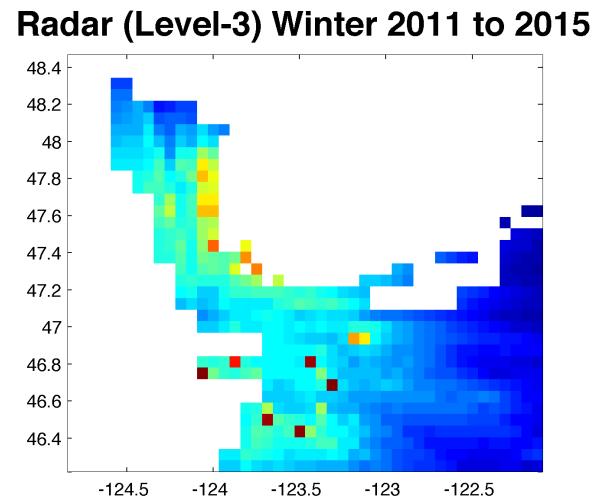
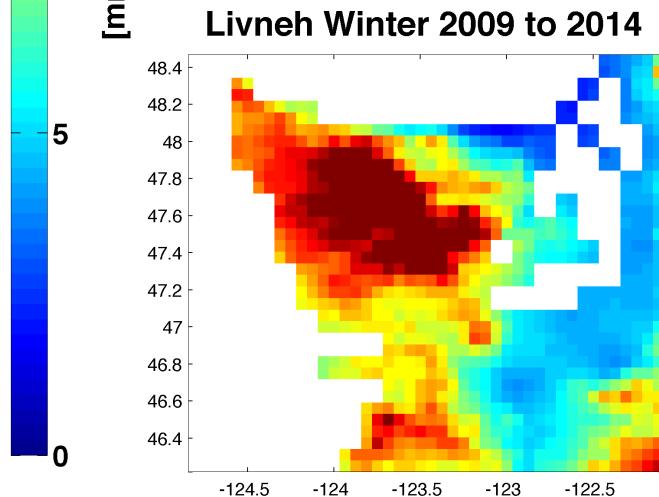
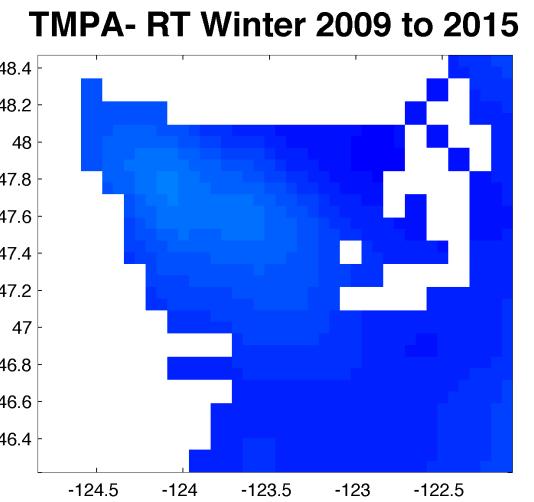
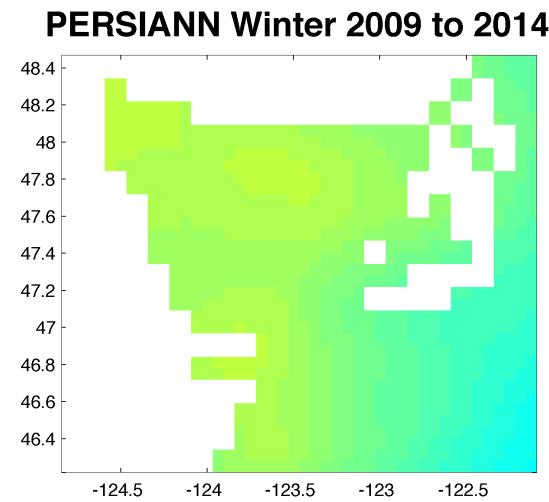
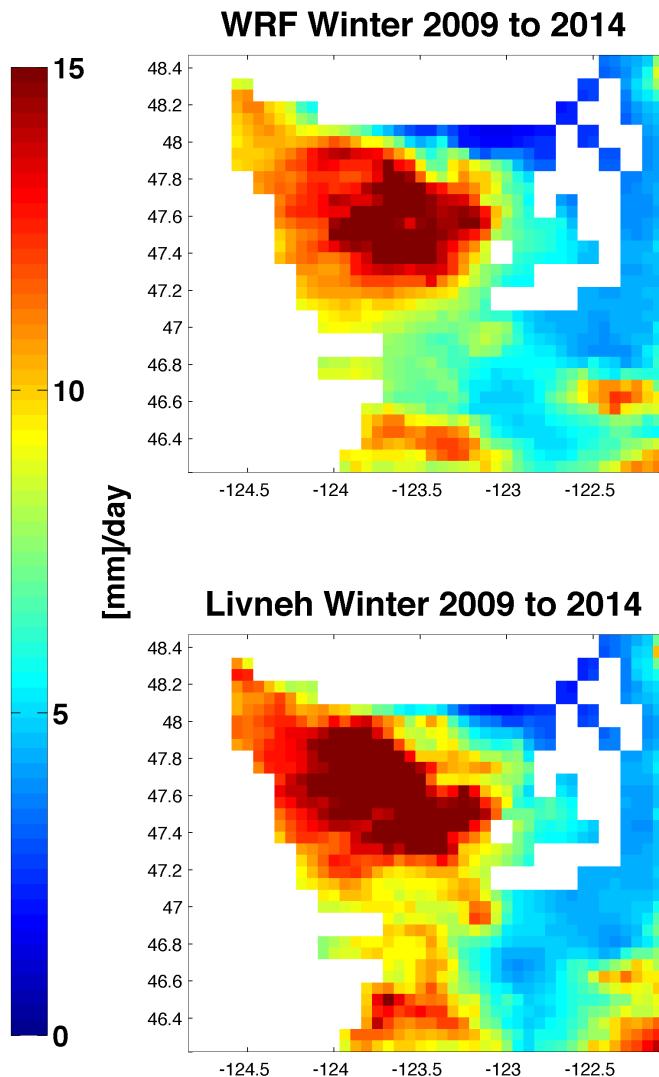
Comparison of Daily Average ST-IV and Livneh Datasets Against WRF



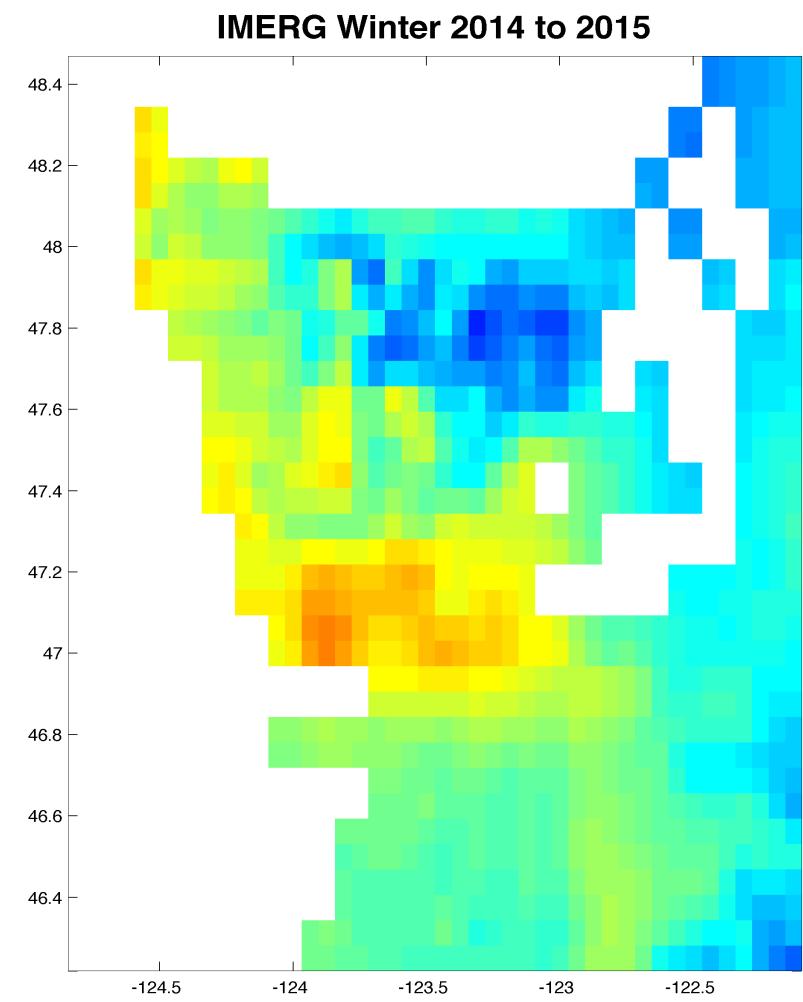
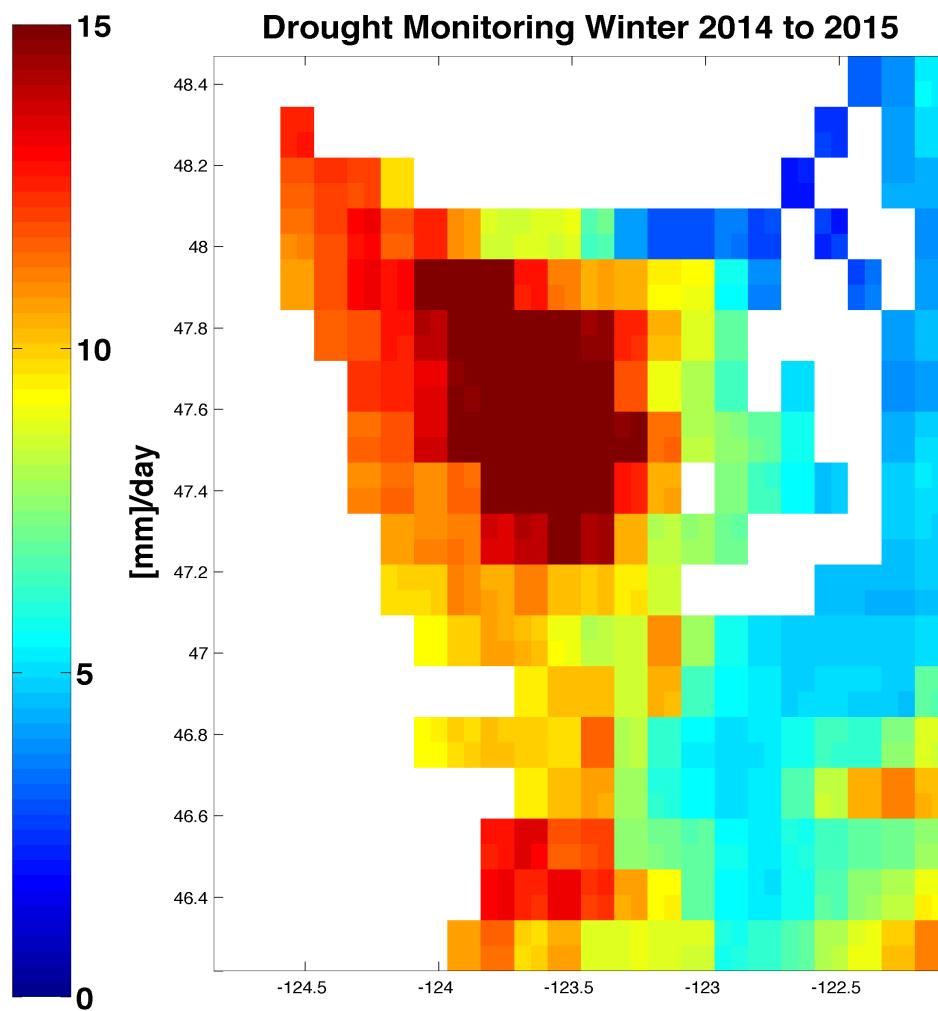
30 Days Moving Average Comparison (OLYMPEX domain average)



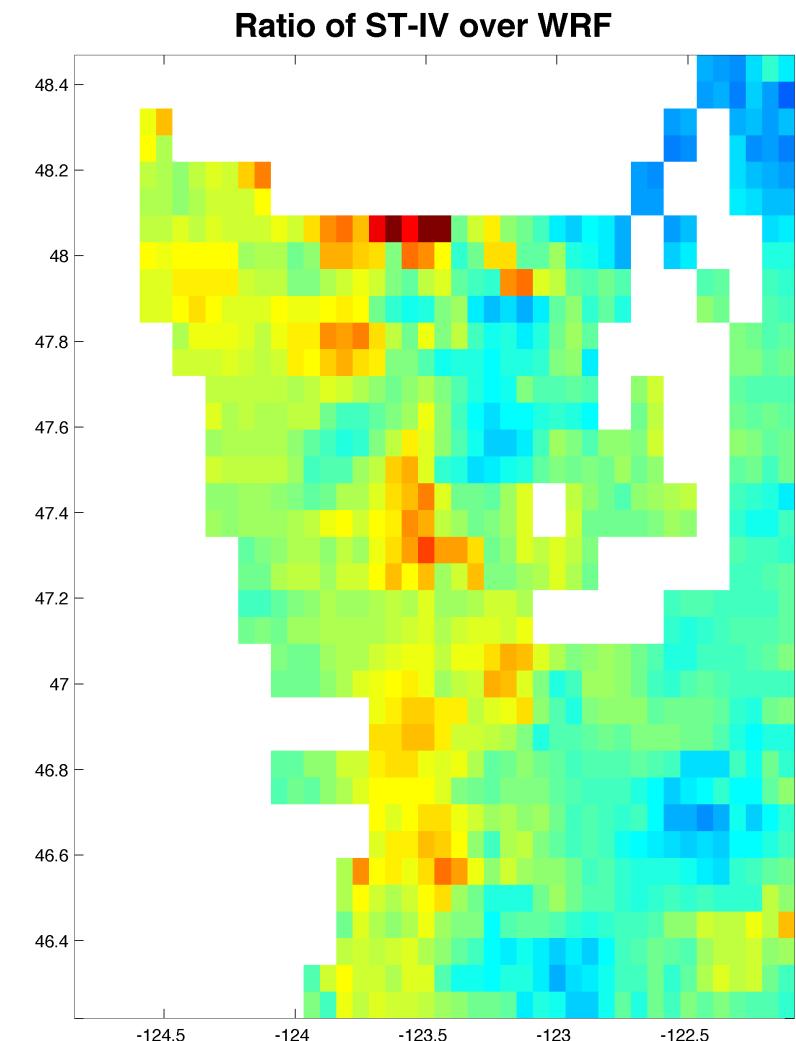
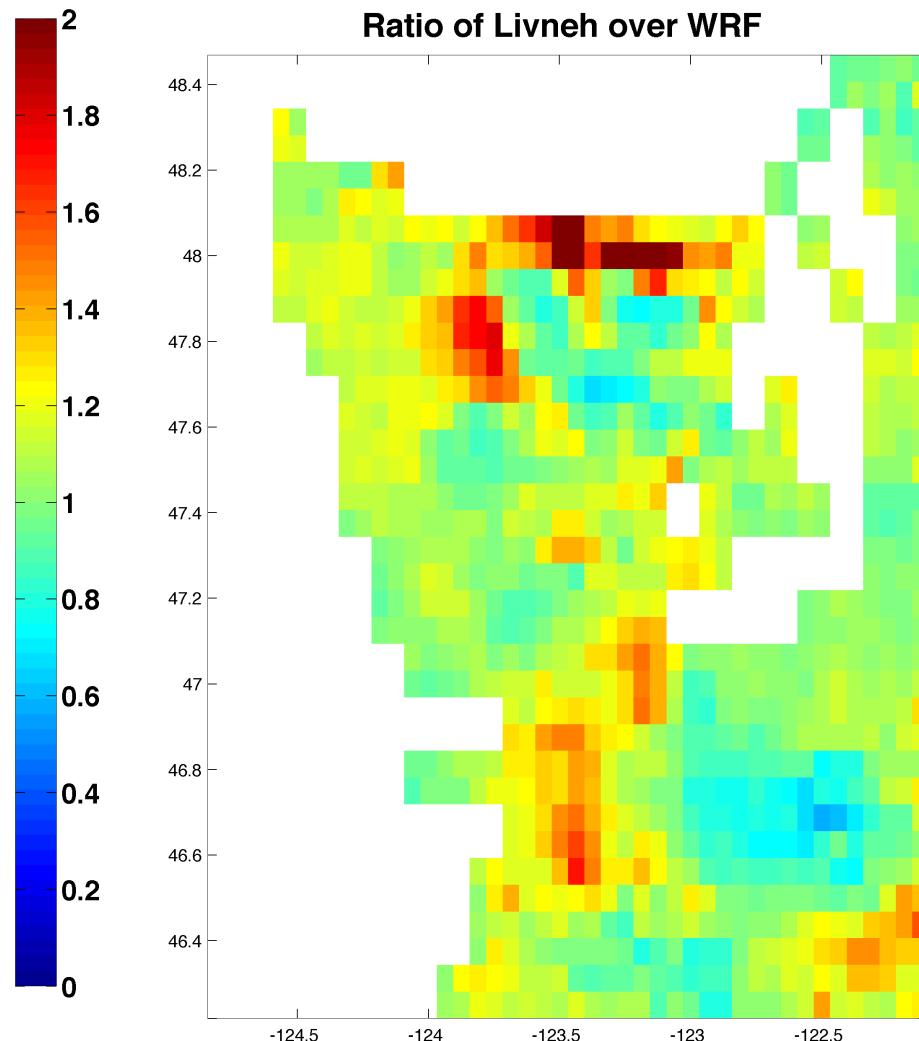
Winter (November to March) Daily Precipitation Comparison Over Olympic Peninsula



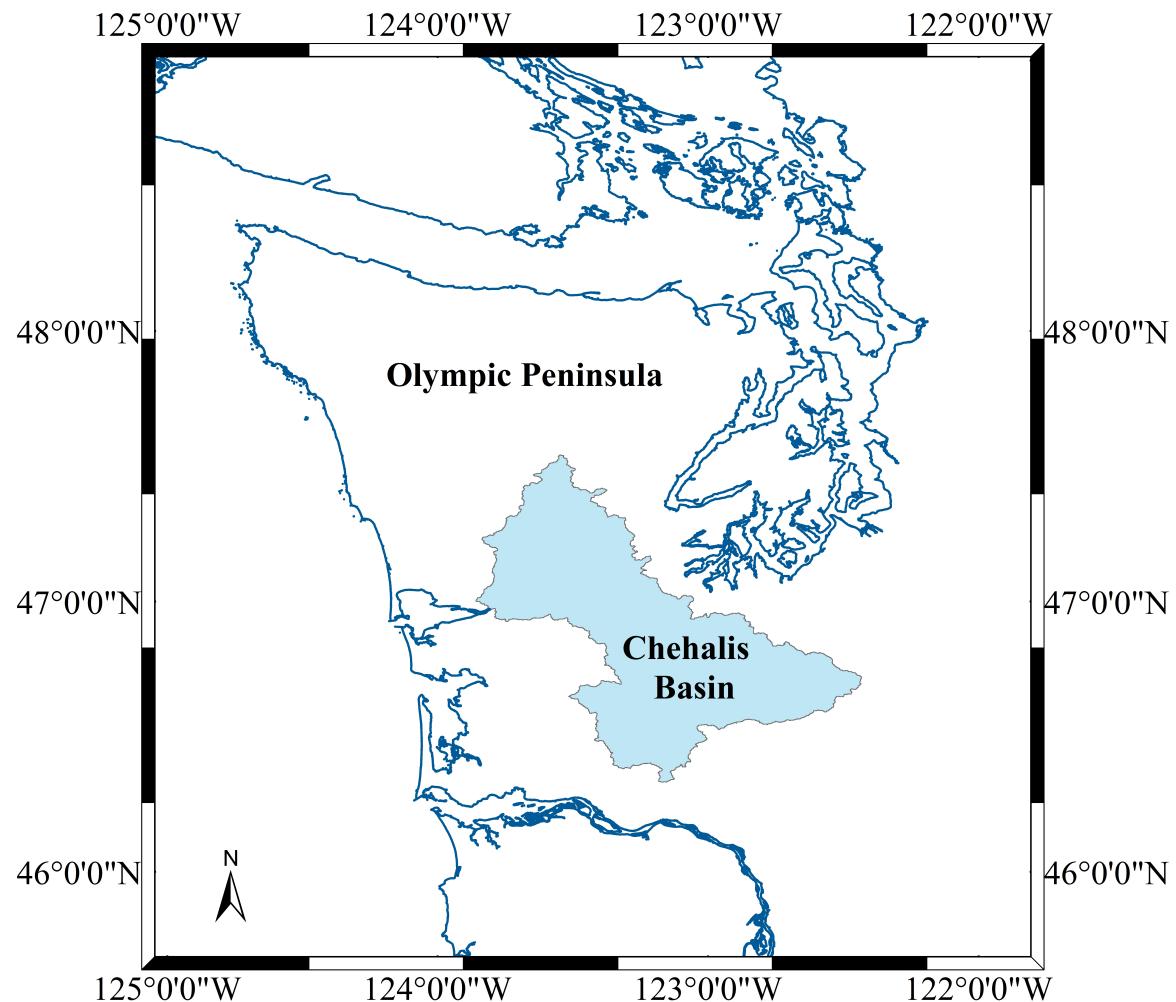
Winter (November to March) Daily Precipitation Comparison Over Olympic Peninsula



Comparison of Winter Daily Average ST-IV and Livneh Datasets Against WRF

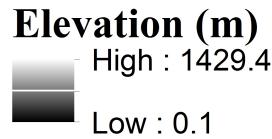


Test Site: Chehalis Basin



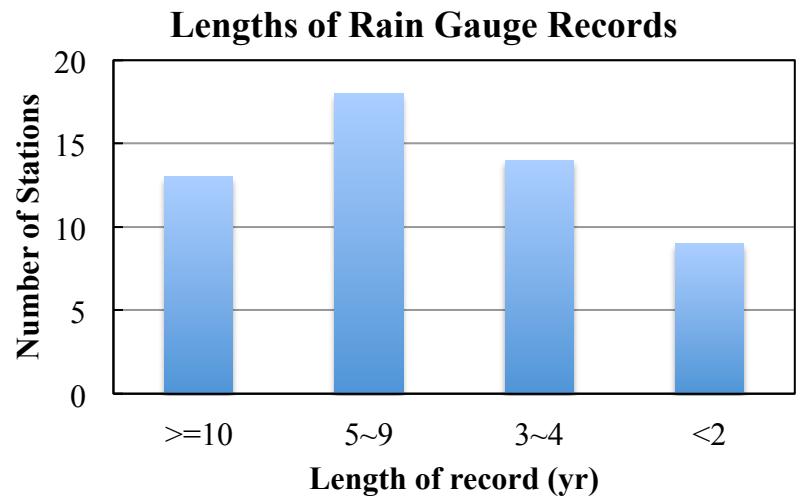
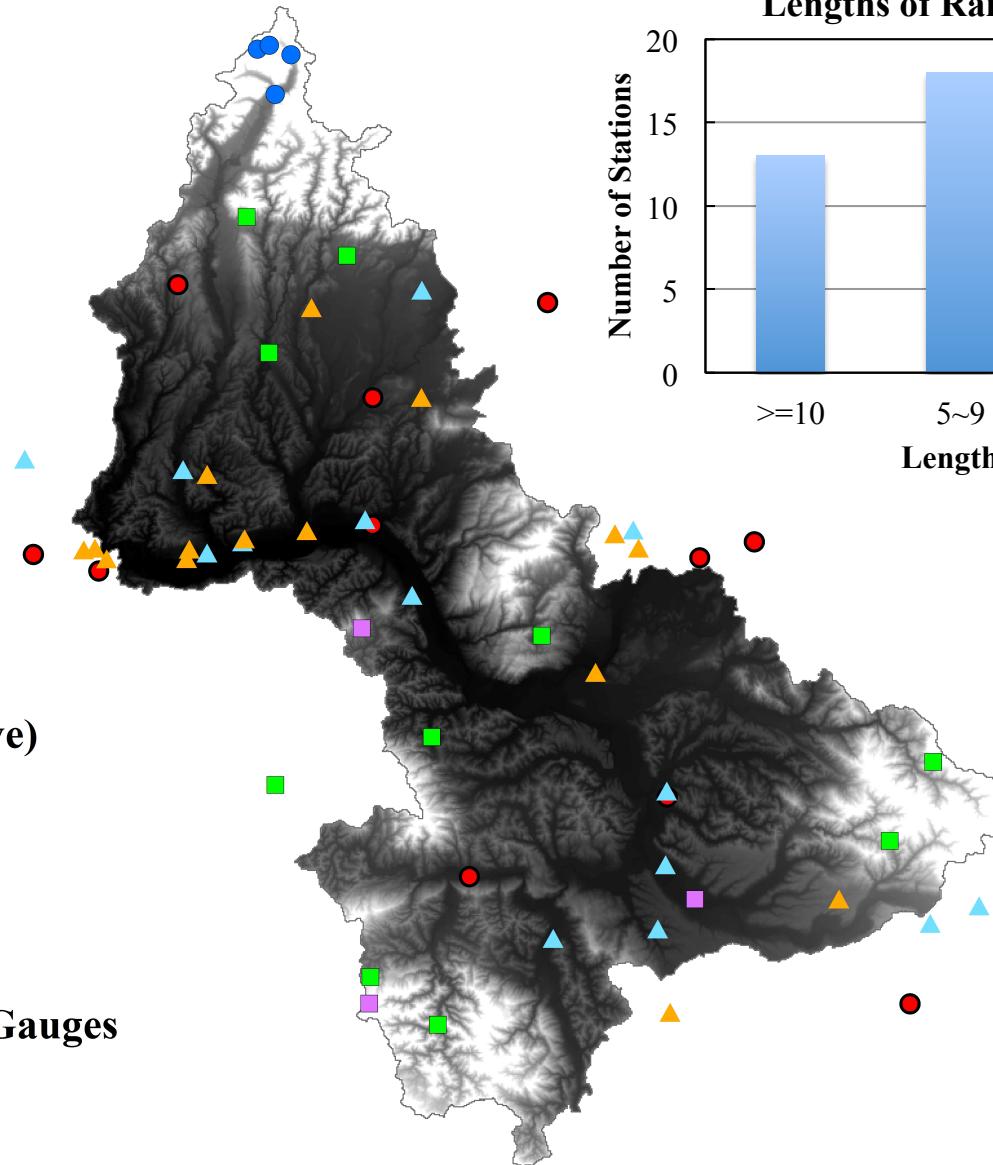
Map of Rain Gauges in Chehalis Basin

Legend



Rain Gauges

- COOP Stations (Active)
- ▲ CocoRahs (Inactive)
- ▲ CocoRahs (Active)
- HADS
- RAWS
- Planned Wynoochee Gauges



Generating Reference Precipitation Data Set

- **Gridded data set of Livneh et al. (2013)**

Gridding Method: Synergraphic Mapping System (SYMAP);

Spatial resolution: 1/16th degree;

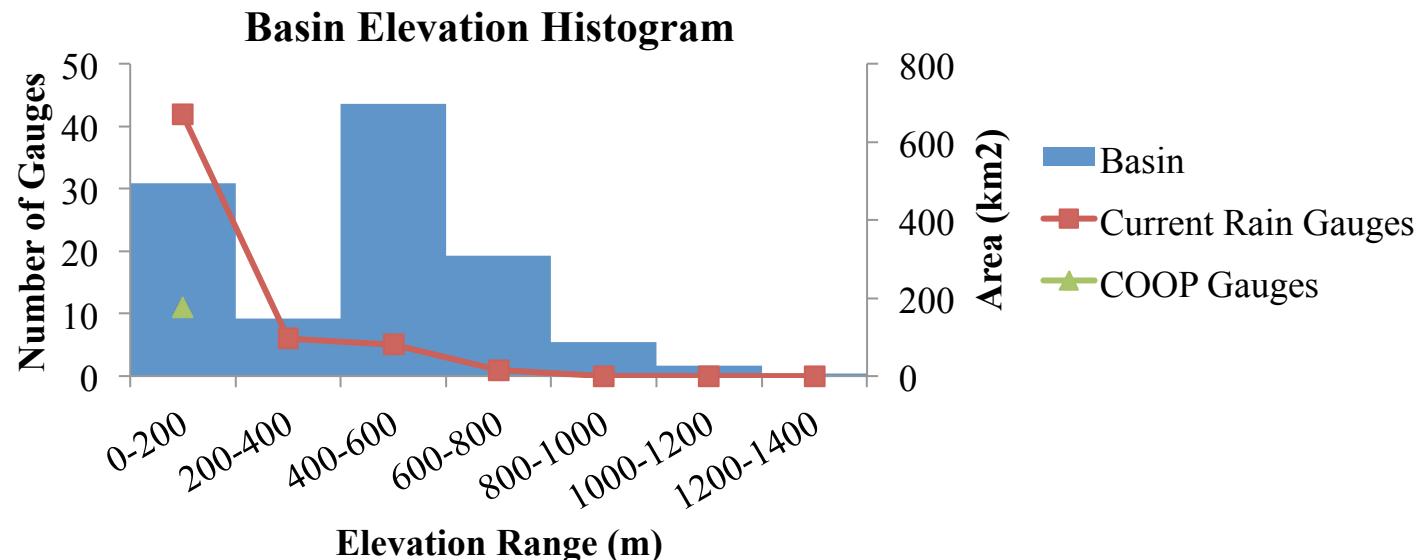
Observation Gauges: NOAA Cooperative Observer (COOP) stations;

Scaled on a monthly basis to match the long-term mean of PRISM (1981-2010);

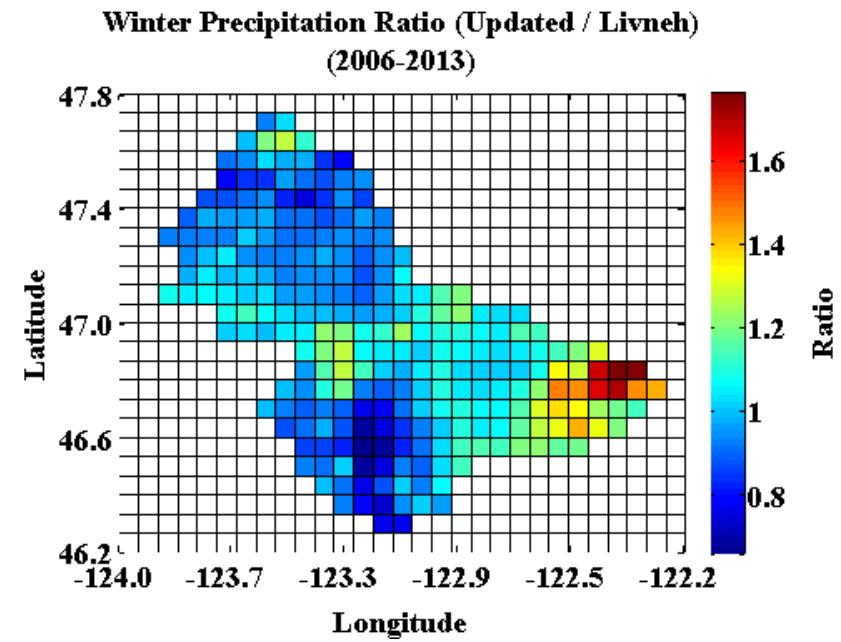
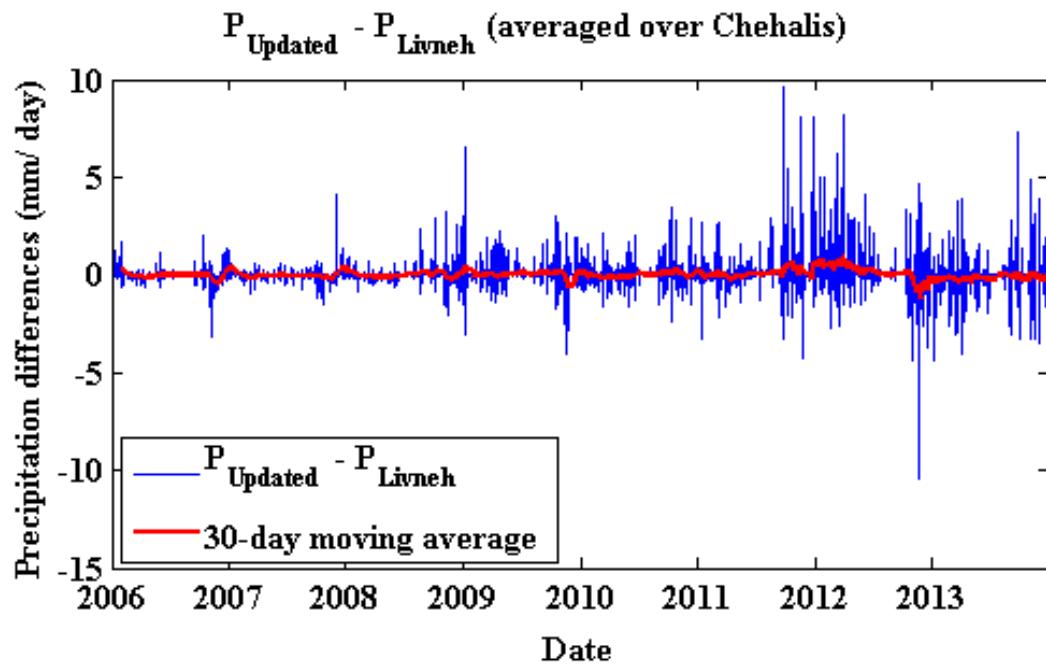
Data set period: 1915~2013

- **Updated data set**

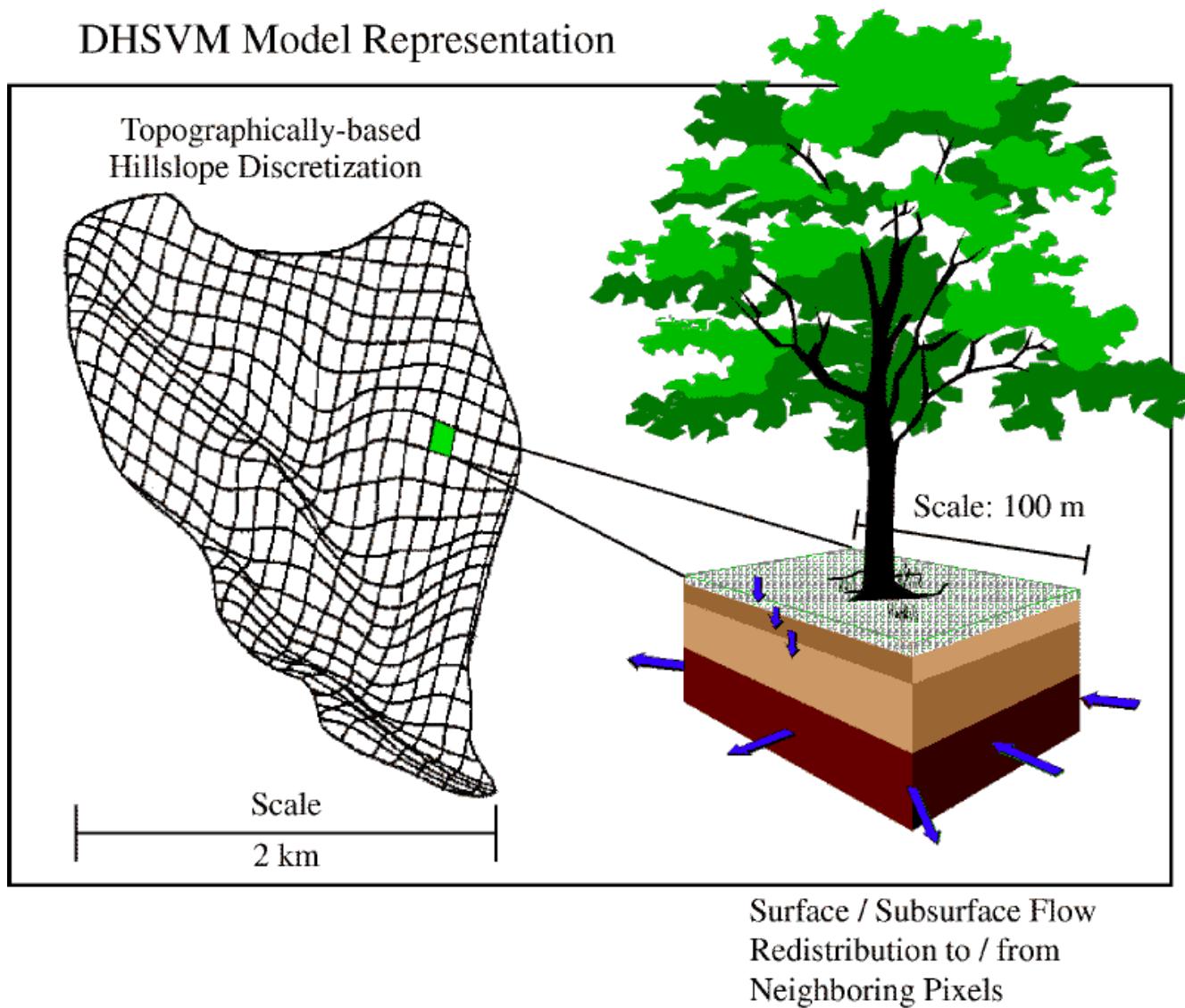
The data set was extended to May, 2015 following the gridding method of Livneh et al. (2013) but with more gauges (CocoRahs, HADS and RAWS).



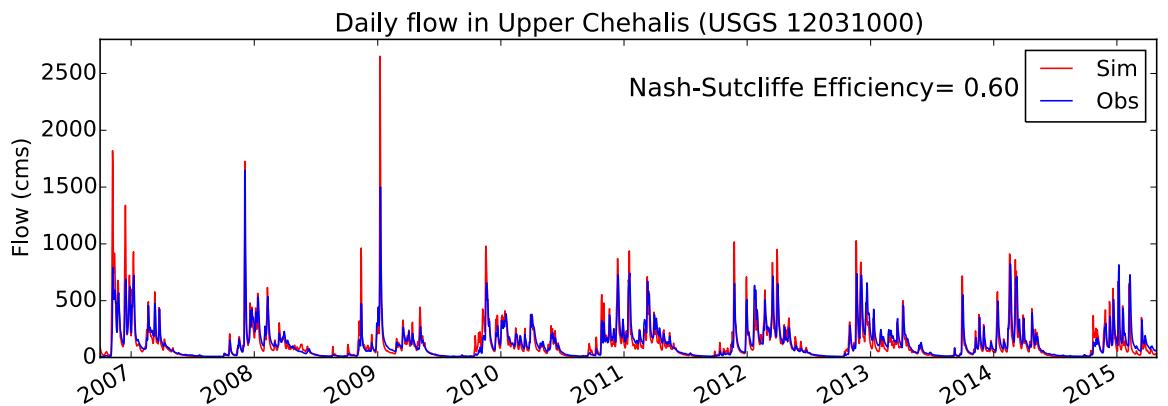
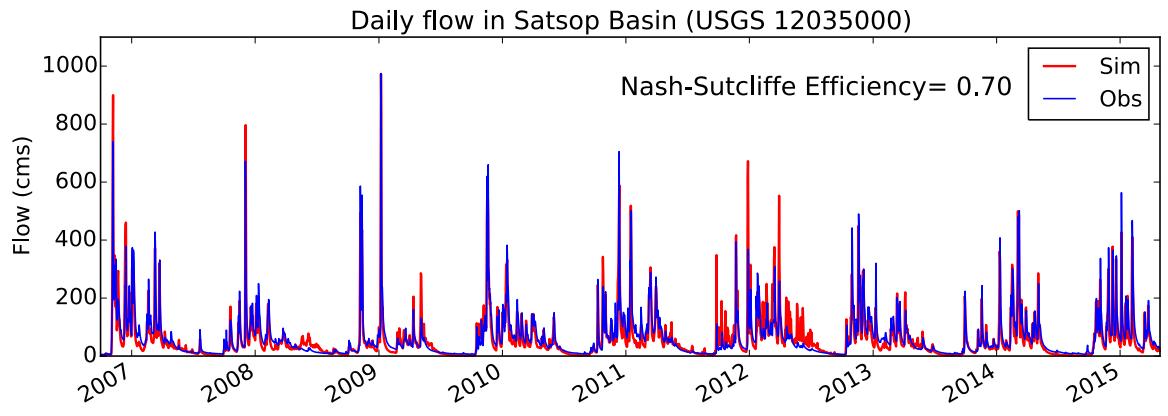
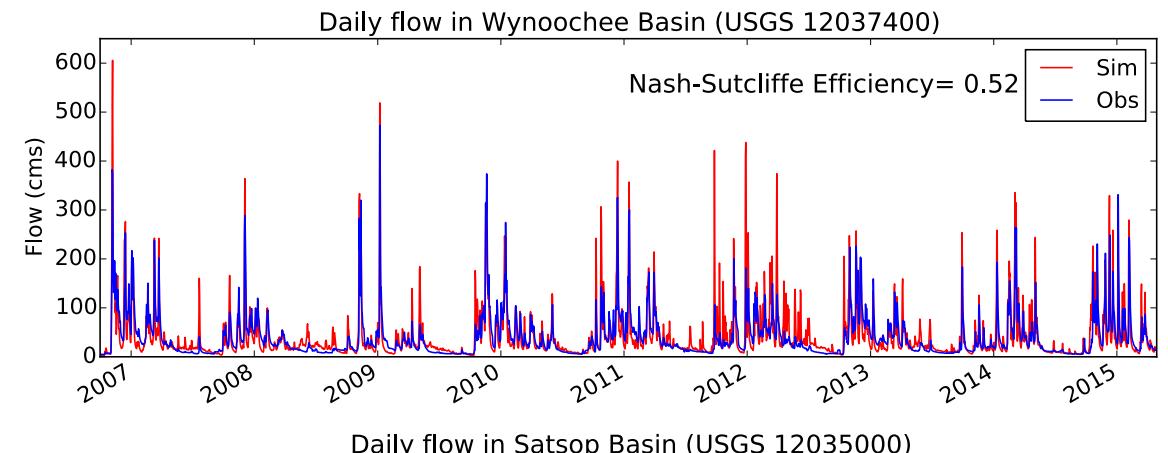
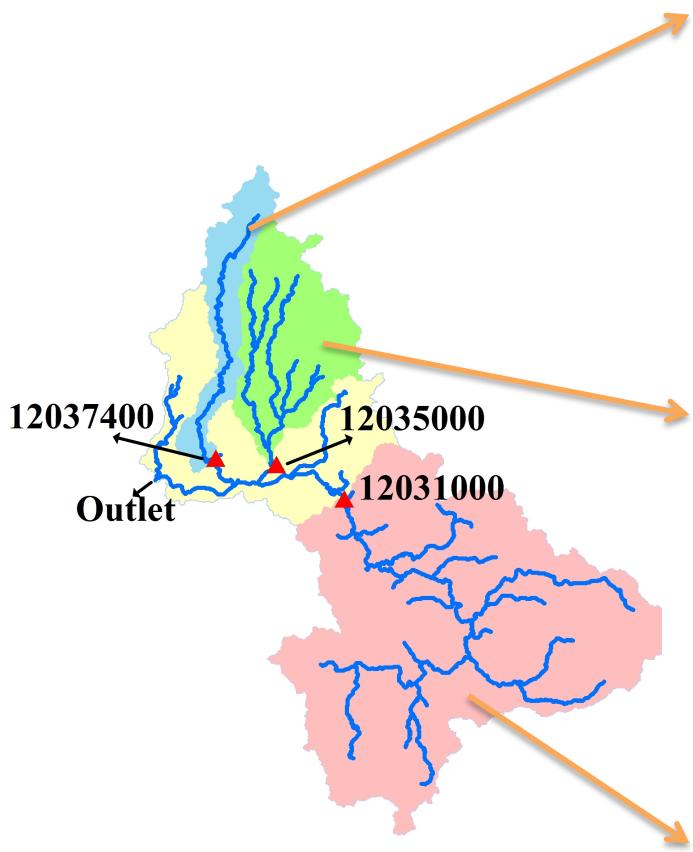
Comparison of Livneh's and Updated Data Sets



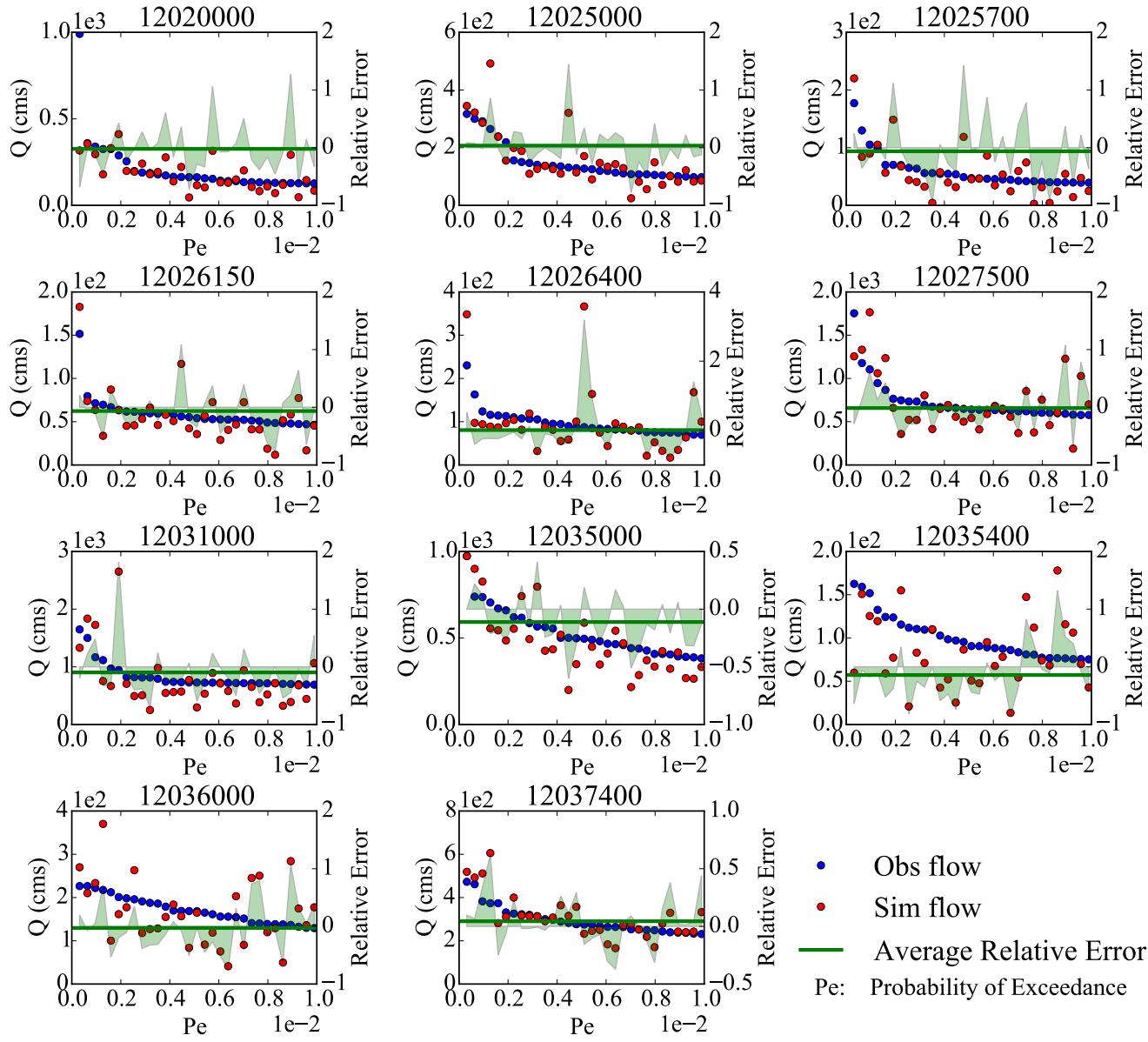
The Distributed Hydrology-Soil-Vegetation Model (DHSVM)



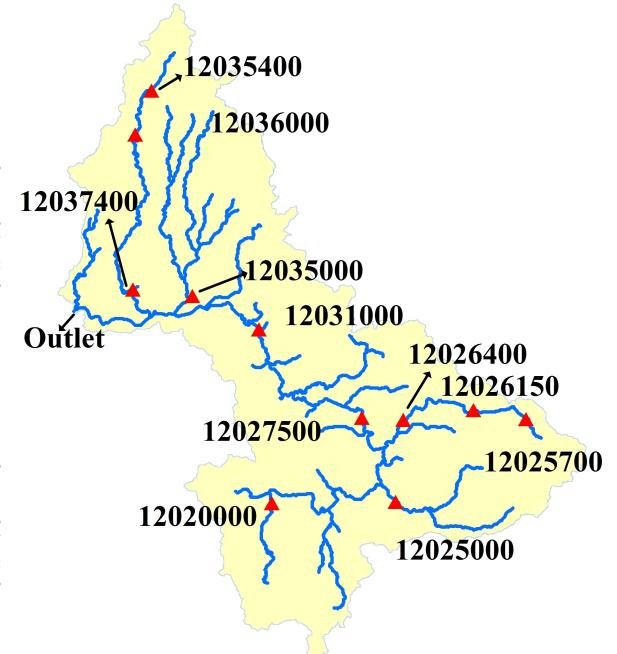
Streamflow simulation using updated data set



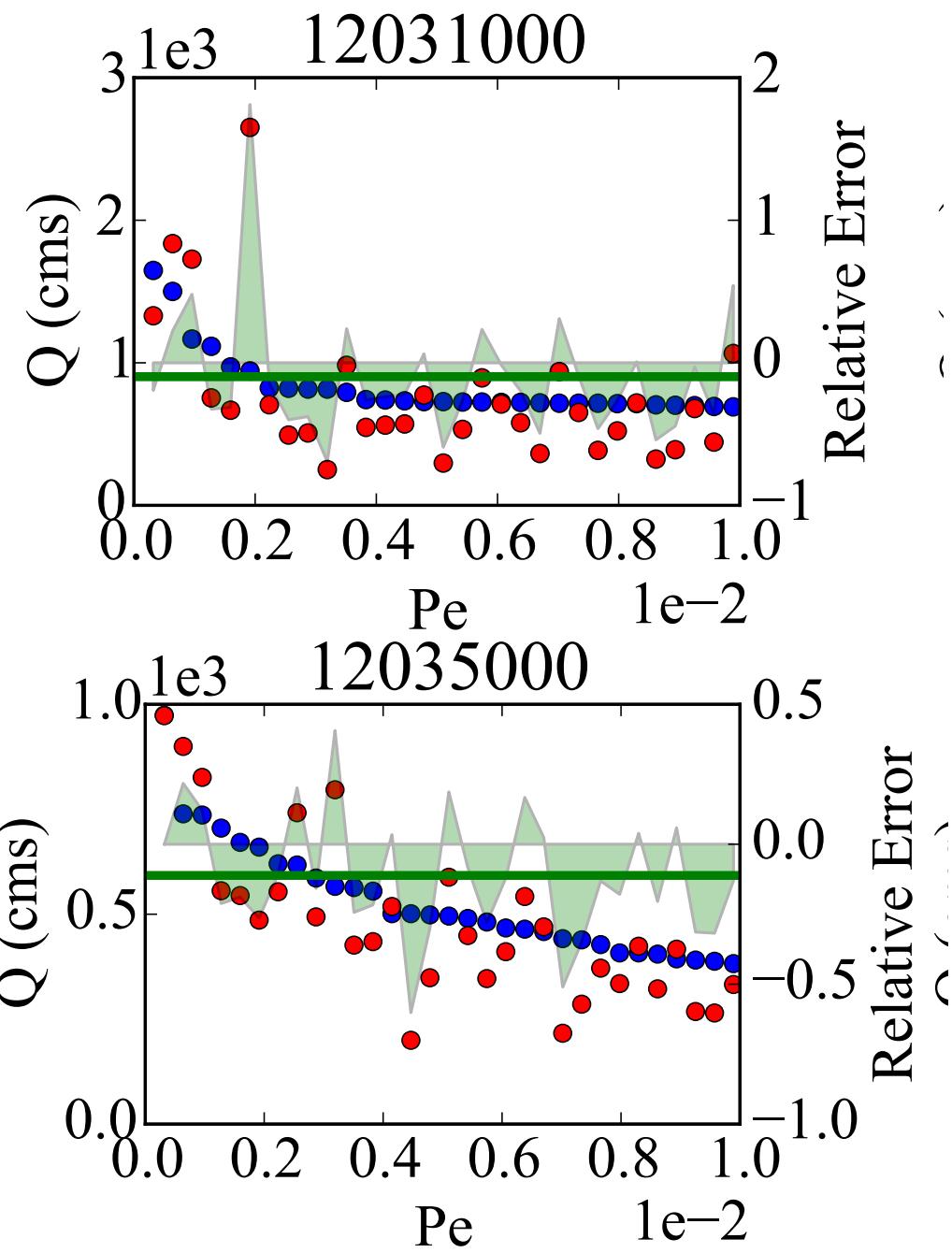
Evaluation of the simulation of stream flow extremes with updated data set



Largest 1% streamflow over 2006~2015



- Obs flow
- Sim flow
- Average Relative Error
- Pe: Probability of Exceedance



Comparison of Livneh's and updated Data Sets in Extreme Streamflow Simulation

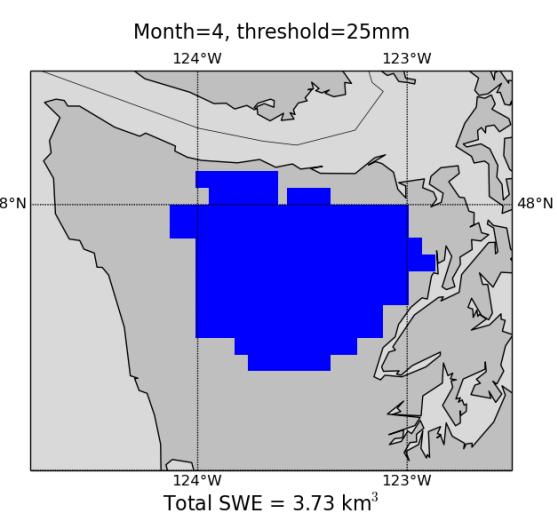
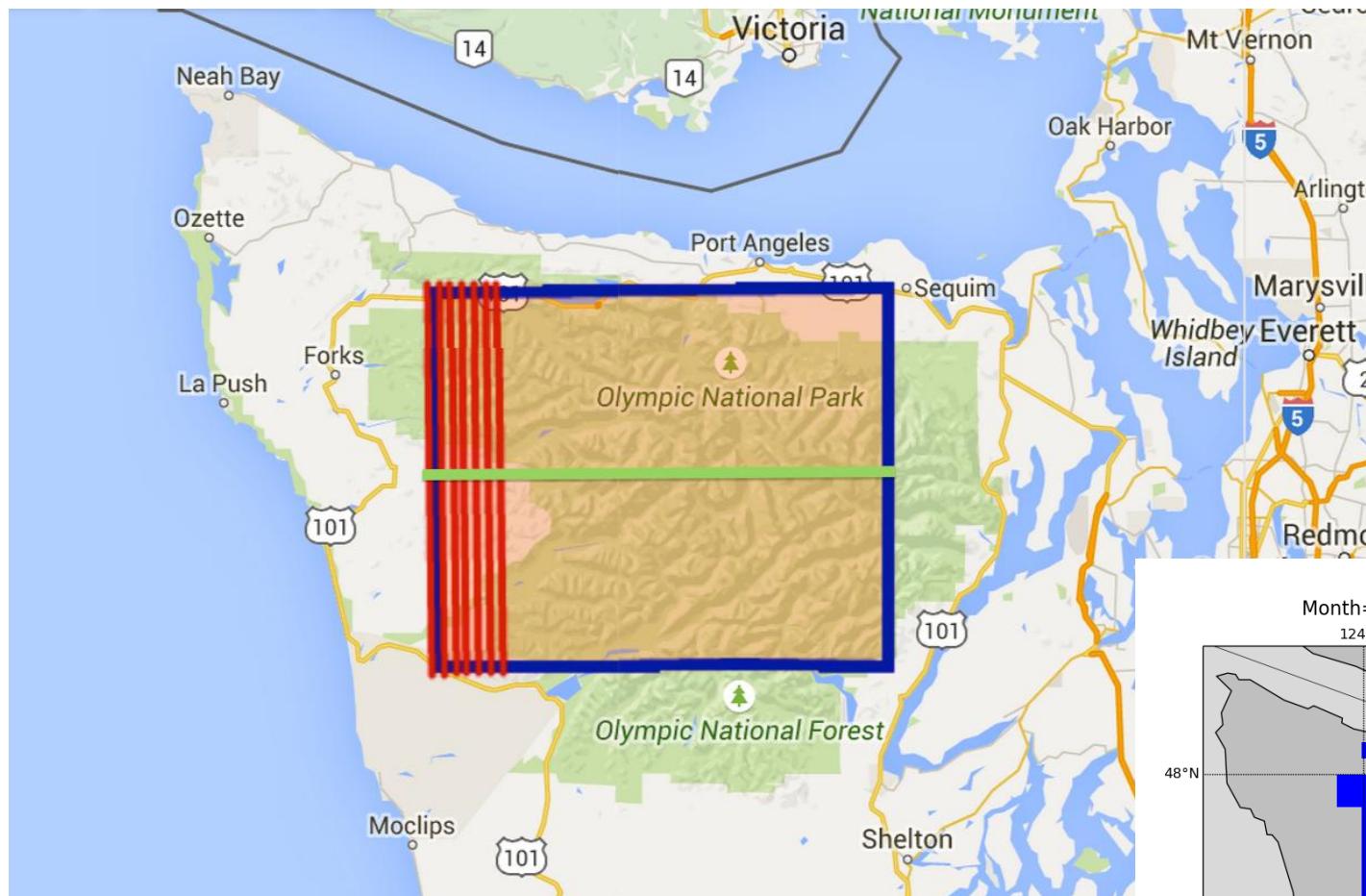
Table 1. Average relative error of largest 1% streamflow simulation over 2006~2015

USGS Gauge	Average Relative Error	
	Livneh et al. (2013)	Updated data set
12020000	18.3%	-2.0%
12025000	8.5%	3.6%
12025700	-4.7%	-6.2%
12026150	-5.4%	-6.6%
12026400	-3.4%	0.7%
12027500	5.2%	-1.3%
12031000	6.4%	-9.7%
12035000	-1.0%	-11.1%
12035400	-1.7%	-14.2%
12036000	8.3%	-2.7%
12037400	-34.0%	4.5%
max	18.3%	4.5%
min	-34.0%	-14.2%

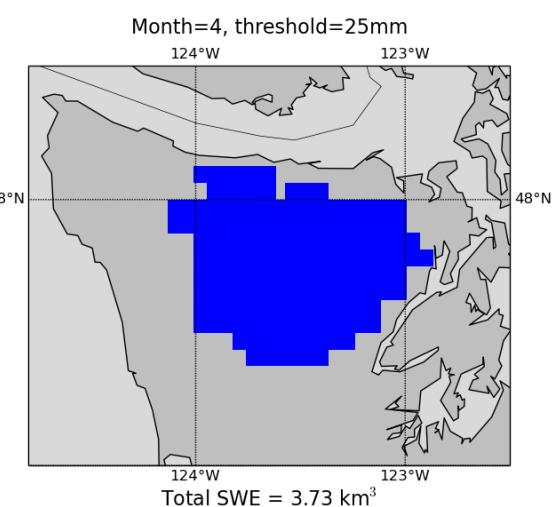
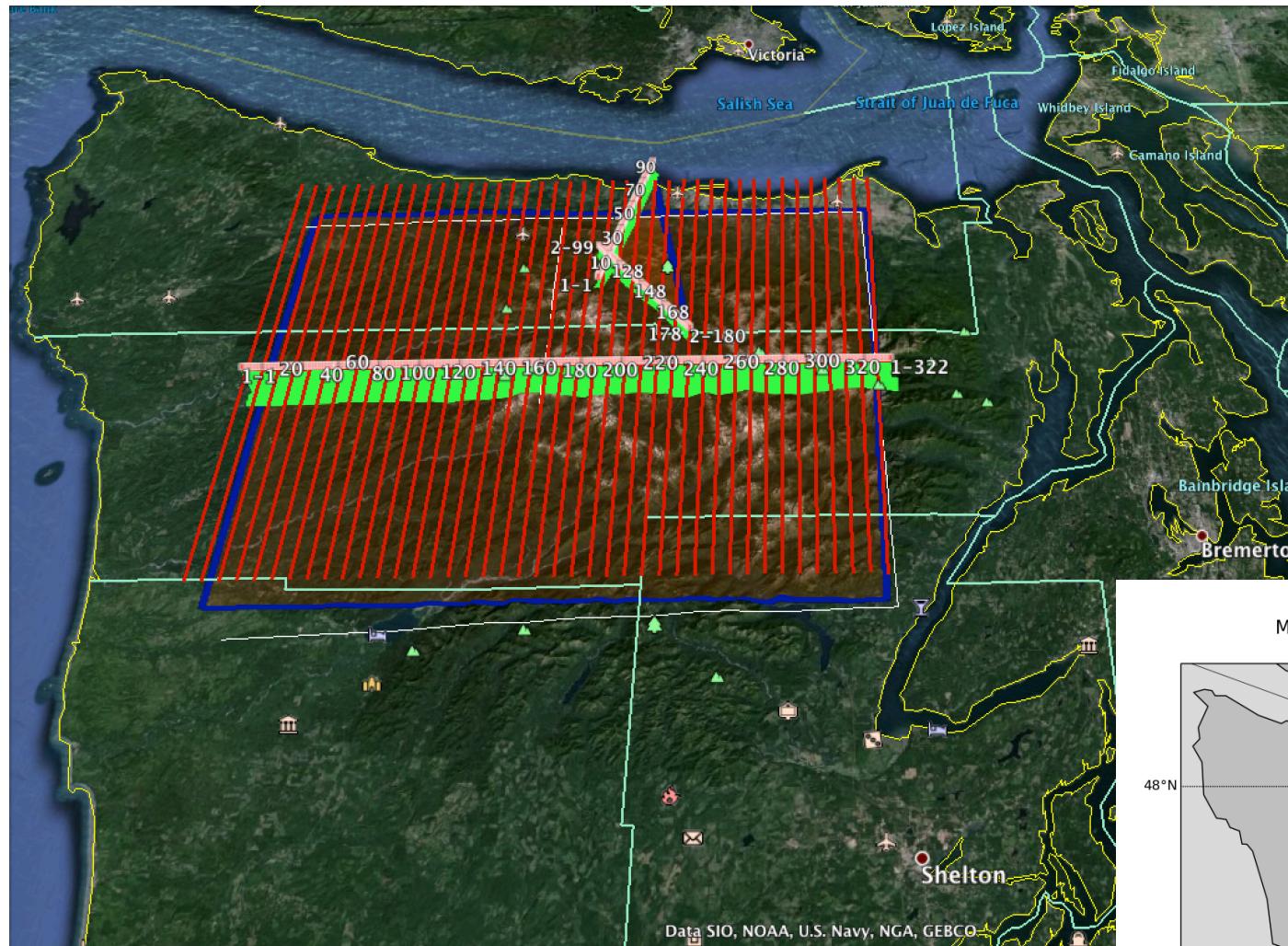
Airborne Snow Observatory (ASO)

- LIDAR-based surface elevation at high ($\text{o}(meters)$) spatial resolution
- Background flown for snow-free conditions (Sep 2014)
- Plan to fly several (~3) times during winter 15-16
- Provides maps of snow dept (by difference from background); conversion to Snow Water Equivalent (SWE) based on limited density obs + modeling; variability in depth is generally much $>$ than in density
- Flight lines are over that portion of OLYMPEX domain with elevation $> \sim 2000$ ft

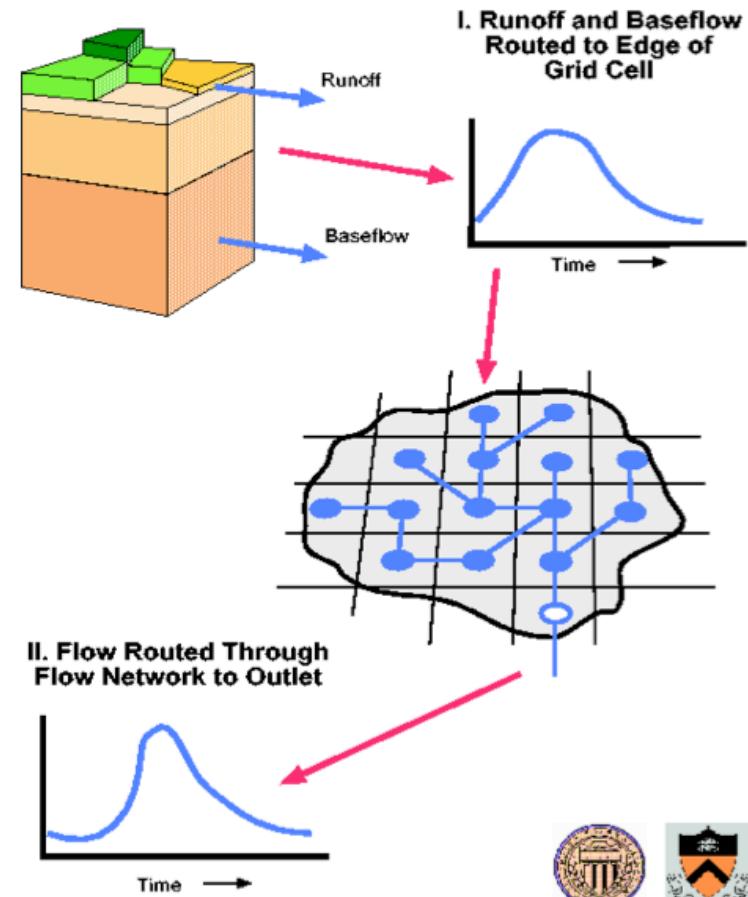
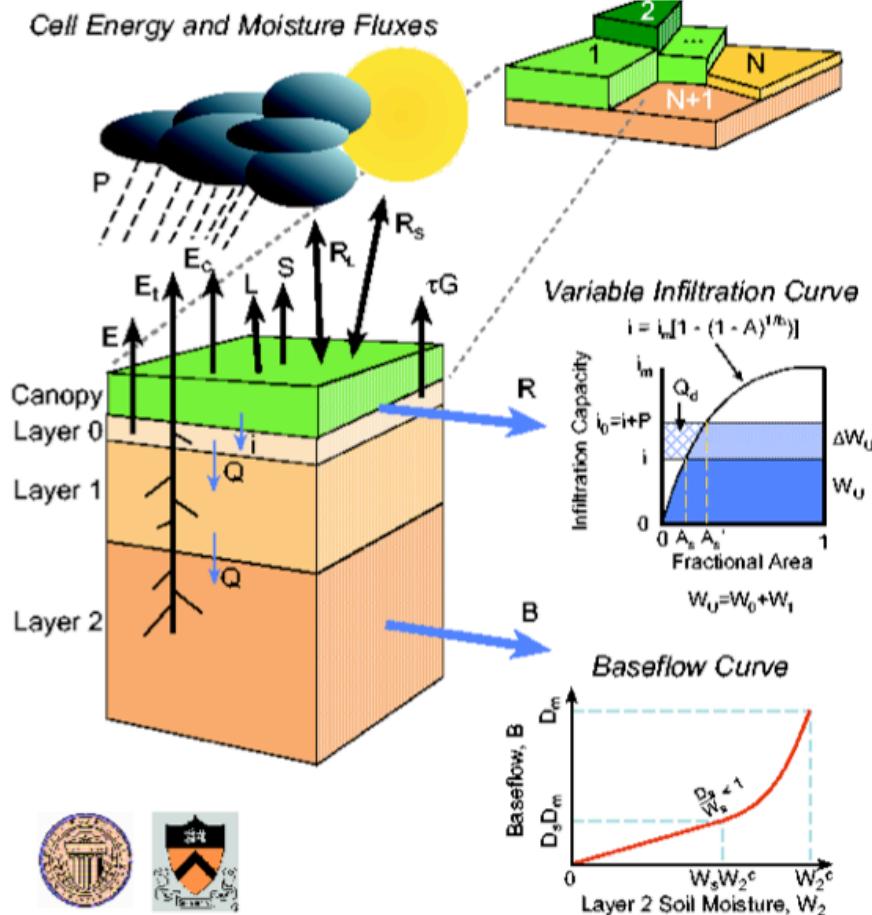
ASO flight lines Sep 2014



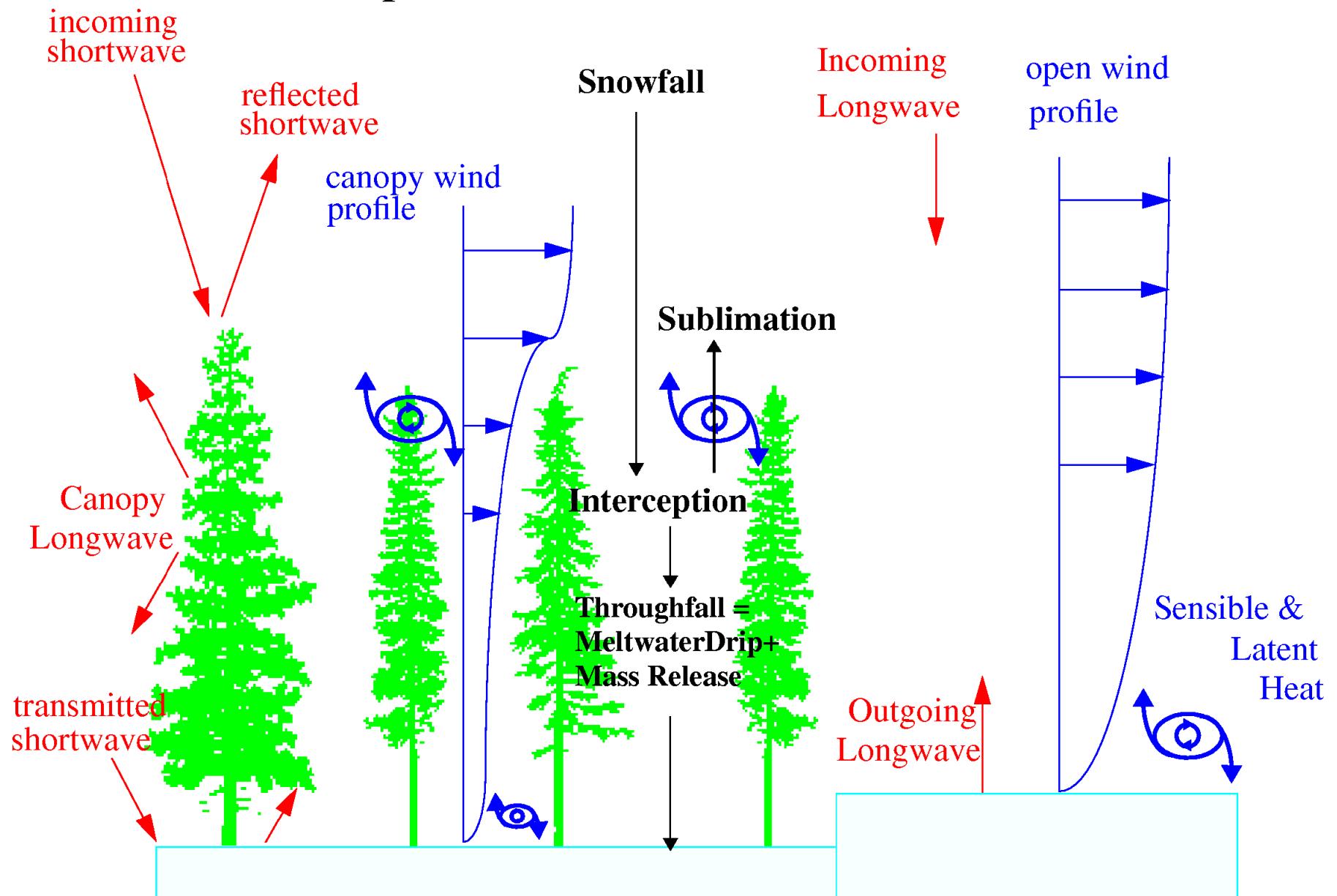
ASO flight lines Sep 2014



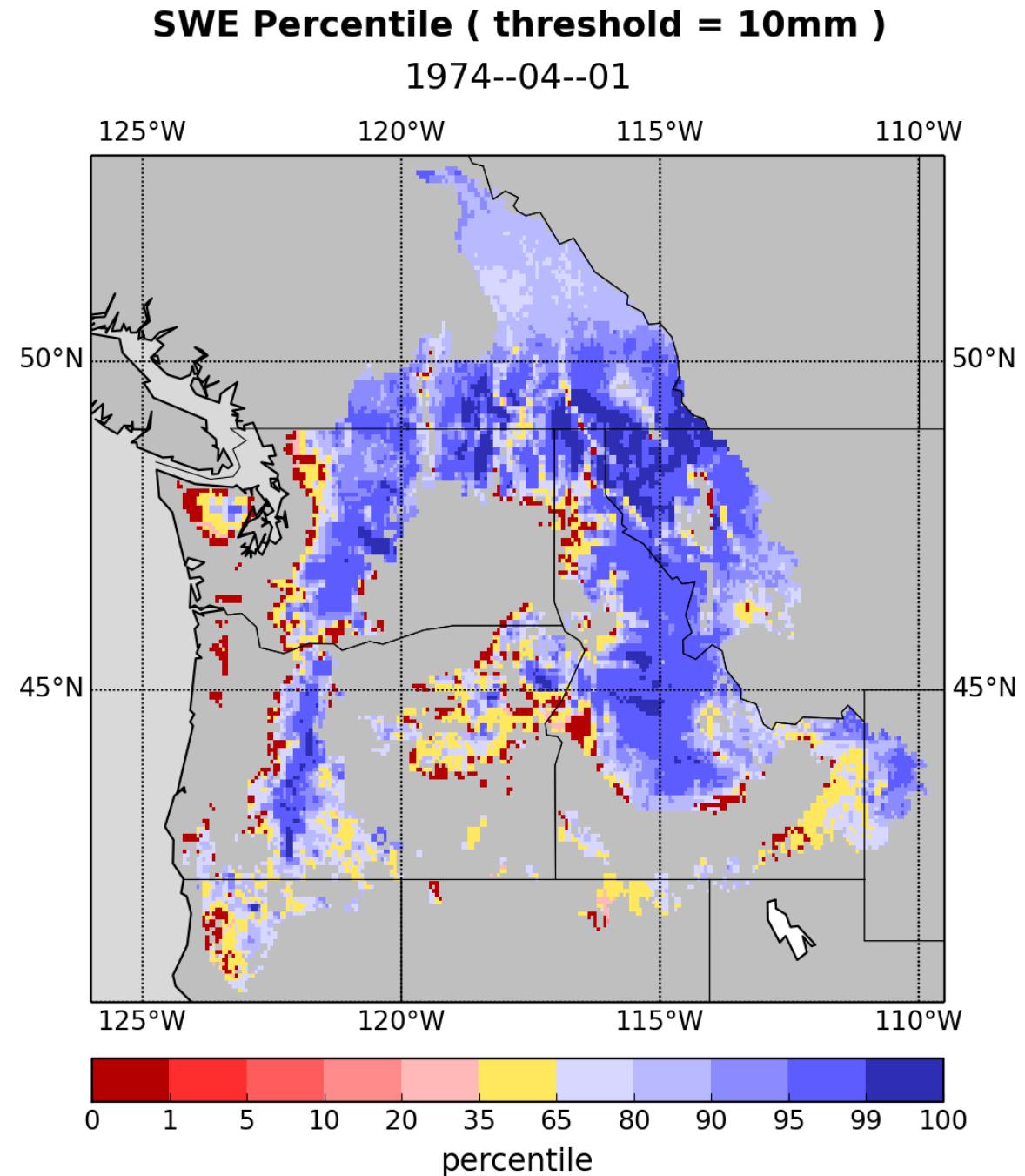
Variable Infiltration Capacity land surface (hydrology) model



Snow processes in a forest environment



VIC model SWE
Apr 1, 1974
(from PWN
drought
monitor
archive)



Next Steps

- Integrate radar Level 3 products with the updated station data as the reference data set
- Evaluate the performance of PMM products in extreme streamflow simulation
- Diagnose streamflow forecast errors